



CLIENTS | PEOPLE | PERFORMANCE

Main Roads Western Australia

Report for North West Coastal Highway
Strategic Material Pit SLK 655A and 655B

Preliminary Environmental Impact
Assessment

April 2012



This Report: has been prepared by GHD Pty Ltd (GHD) for Main Roads Western Australia (MRWA) and may only be used and relied on by MRWA for the purpose agreed between GHD and MRWA as set out in Section 1.2 of this Report.

GHD otherwise disclaims responsibility to any person other than MRWA arising in connection with this Report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in the Report and are subject to the scope limitations set out in the Report.

The assessment is based on the Project footprint provided by MRWA, as listed in Section 1.1 and shown in Figure 1. Any changes to the project, outside the description provided above, are outside the scope of this assessment.

The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the Report. GHD has no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was prepared.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD described in this Report (refer Section 2.2). GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this Report are based on information obtained from, and sampling undertaken at, or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this Report are constrained by the particular site conditions, in particular, a lack of access to all parts of the area studied. As a result, not all relevant site features and conditions may have been identified in this Report.

Site conditions may change after the date of this Report. GHD expressly disclaims responsibility arising from, or in connection with, any change to the site conditions; and the requirement to update this Report if the site conditions change.

Where GHD has relied upon external data, namely publicly available database, to identify species previously recorded in the area, the accuracy of this data lies with the provider, not with GHD.

This advice is considered valid until five years after the date of finalisation of the report whereupon the data contained within may no longer remain relevant.



Contents

Executive Summary	i
1. Introduction	1
1.1 Background	1
1.2 Scope of Work	1
2. Methodology	2
2.1 Desktop Assessment	2
2.2 Field Assessment	3
3. Environmental Aspects	5
4. Desktop Assessment	7
4.1 Project Area	7
4.2 Previous Surveys	7
4.3 Climate	7
4.4 Land Use	7
4.5 Geology and Soils	8
4.6 Contaminated Sites	8
4.7 Acid Sulphate Soils	8
4.8 Environmentally Sensitive Areas	9
4.9 Hydrology	9
4.10 Noise and Vibration	10
4.11 Ambient Air Quality	10
4.12 Reserves and Conservation Areas	10
4.13 Vegetation	10
4.14 Flora	12
4.15 Diseases or pathogens	16
4.16 Fauna	16
5. Field Assessment	19
5.1 Survey Timing	19
5.2 Nomenclature	19
5.3 Taxonomic Identification	19
5.4 Hydrology	19
5.5 Vegetation	20



5.6	Threatened Ecological Communities	23
5.7	Flora	23
5.8	Fauna	29
6.	Clearing of Native Vegetation	33
6.1	Assessment Against the Ten Clearing Principles	33
7.	Recommendation and Approvals Required	34
7.1	Recommendations	34
7.2	Approvals	34
8.	References	35

Table Index

Table 1	Environmental aspects	5
Table 2	Summary of Project Area Surveyed	7
Table 3	Beard Vegetation Associations within the Project Area	11
Table 4	Vegetation Extent and Status	12
Table 5	Results of Conservation Significant Flora Database Searches	14
Table 6	Conservation Significant Fauna Indicated from Database Searches to Occur within the Vicinity of the Project Area	18
Table 7	Vegetation Condition Scale (after Keighery, 1994)	21
Table 8	Project Area Vegetation Type	22
Table 9	Location of <i>Acacia startii</i>	25
Table 10	Department of Agriculture and Food Declared Plant Control Classes	28
Table 11	Conservation Categories and Definitions for <i>Environmental Protection and Biodiversity Conservation Act</i> (1999) Listed Flora and Fauna Species	45
Table 12	<i>Western Australia Wildlife Conservation Act</i> (1950) Conservation Codes	45
Table 13	Department of Environment and Conservation Priority Fauna Codes	46
Table 14	Department of Environment and Conservation Priority Flora Codes	46



Table 15	Flora List for North West Coastal Highway SLK 660 Material Pits 3 and 4	0
Table 16	Fauna List for North West Coastal Highway SLK 660 Material Pits 3 and 4	3

Figure Index

Figure 1	Project Location	38
Figure 2	Project Area Vegetation Type	39
Figure 3	Project Area Vegetation Condition	40
Figure 4	Project Area Environmental Constraints	41

Appendices

- A Conservation Categories
- B Project Area Flora List
- C Project Area Fauna List
- D Assessment Against the Ten Clearing Principles



Executive Summary

Main Roads Western Australia (MRWA) proposes to widen the seal of the North West Coastal Highway (NWCH) between Carnarvon and Nanutarra to allow for increased traffic flow. To undertake these works considerable road building material needs to be sourced.

The proposed locations of the Material Pits will take place at the following:

- NWCH SLK 655A left hand side of NWCH; and
- NWCH SLK 655B right hand side of NWCH.

MRWA proposes to clear one to two hectares of vegetation every two years, or when maintenance and project works are required of each Material Pit. MRWA has advised that they will take a staged pit development approach, which means each one to two hectares will be revegetated at each stage, before opening up new areas of clearing.

MRWA commissioned GHD Pty Ltd (GHD) to complete a Preliminary Environmental Impact Assessment (PEIA) of the proposed material pit locations.

The results of the PEIA indicated that:

- No Aboriginal listed or European Heritage listed sites occur within the vicinity of the Project Area;
- The Project Area does not contain any known contaminated sites;
- The Project Area has low to extremely low probability of Acid Sulphate Soils;
- No Ramsar Listed Wetlands or Australian Nationally Significant Wetlands occur in the Project Area;
- According to *WetlandBase*, no wetlands occur within the vicinity of the Project Area;
- No defined watercourses are present within the Project Area. However, one defined watercourse was identified four kilometres north of the Project Area, the Lyndon River. This watercourse will not be impacted by the proposed works;
- There are no residents in close proximity of the proposed works that will be impacted by construction noise or vibration;
- No Threatened Ecological Communities were present within the vicinity of the Project Area;
- The Project Area occurs within the buffer of a series of Priority Ecological Communities, which forms a part of the Carnarvon Basin Survey (CB) buffers of the Lake MacLeod Invertebrate Assemblages for CB 76; CB 77; CB 78 and CB 79;
- Two Vegetation Associations are known within the vicinity of the Project Area. These are considered of *Least Concern*;
- A total of two vegetation types were delineated from the field survey, including Open Grassland on steppes and Cleared/Degraded;
- The Project Area contained mostly unaltered vegetation, with the exception of historical disturbance associated with removing material from existing Material Pits and access tracks;
- The Project Area was observed to have *Good to Degraded* vegetation condition;
- A total of 25 flora taxa from nine families were recorded within the Project Area;



- ▶ No Threatened (Declared Rare) Flora taxa were recorded from the Project Area;
- ▶ One Priority Flora species were recorded within the vicinity of the Project Area: *Acacia startii* (Priority 3);
- ▶ No weeds or introduced flora were recorded during the field surveys;
- ▶ No Threatened Fauna were recorded during the field surveys;
- ▶ No Priority Fauna species were recorded within the vicinity of the Project Area;
- ▶ No exotic fauna were recorded within the Project Area;
- ▶ An assessment of the clearing of vegetation required for the project indicated that the proposed works are considered unlikely to be at variance with Principle (a) of the Ten Clearing Principles:
 - *Acacia startii* (Priority 3) was recorded in the Project Area at number of locations. GHD considers that this species population within the local and regional area will not be under threat from the proposed project activities;
 - GHD believes that the proposed project activities are likely to enhance the area of preferred habitat and increase germination of this species; and
 - As the records are primarily located in one distinct area of the Project Area, GHD recommends avoiding all known locations;
- ▶ The proposed works is considered to be “Not At Variance” with Principle (d) of the Ten Clearing Principles:
 - The buffer of four Priority Ecological Communities overlaps the Project Rea. These PECs includes CB 76, CB 77, CB 78 and CB 79 of the Lake MacLeod Invertebrate Assemblages. GHD considers that no TECs or PECs will be impacted by this project;
- ▶ The project is considered not to be warrant referral to the Commonwealth Government, Government of Western Australia or Department of Environment and Conservation;

This report is subject to, and must be read in conjunction with, the limitations section of this report and assumptions and qualifications contained throughout the report.



1. Introduction

1.1 Background

The North West Coastal Highway (NWCH) is the main link between regional centres including Geraldton, Carnarvon, Karratha and Port Headland. The highway also provides access to various tourist destinations, mining operations and pastoral communities. The NWCH also provides a travel route for triple road trains operating north of Carnarvon. It is anticipated that over the next coming years the demand for the movement of freight will increase with proposed industry expansions and new mining developments in the Northern Gascoyne and Western Pilbara. The NWCH currently has a nominal seal width of 6.2 m. This is deemed to be unsafe for current and predicted traffic volumes.

MRWA proposes to widen the seal of the NWCH to allow for increased traffic flow. To undertake these works considerable road building material needs to be sourced.

The proposed locations of the Material Pits will be the following:

- ▶ NWCH SLK 655A Left hand side of NWCH; and
- ▶ NWCH SLK 655B Right hand side of NWCH.

MRWA proposes to clear one to two hectares of vegetation every two years, or when maintenance and project works are required. To meet the environmental requirements MRWA commissioned GHD to complete a Preliminary Environmental Impact Assessment (PEIA) of the proposed material pit locations (Figure 1).

1.2 Scope of Work

MRWA has commissioned GHD to undertake a Preliminary Environmental Impact Assessment of the proposed material pit locations.

Preliminary Environmental Impact Assessment

The preparation of the Preliminary Environmental Impact Assessment and subsequent report included the following:

- ▶ Desktop assessment of the area;
- ▶ Field study of relevant biological aspects;
- ▶ Assessment of the project against the *Environmental Protection Act 1986* Ten Clearing Principles; and
- ▶ Consultation with the regulatory stakeholders to determine requirements as required.



2. Methodology

2.1 Desktop Assessment

The desktop assessment was carried out prior to the field survey in order to determine the key environmental aspects that may impact the project. The following factors were examined:

- ▶ A review of Environmentally Sensitive Areas;
- ▶ A review of the Department of Environment and Conservation's (DEC's) Threatened Ecological Communities database;
- ▶ A review of local and regional significance of plant communities;
- ▶ A review of the DEC's Threatened and Priority Flora databases;
- ▶ A review of the DEC's Threatened Fauna database;
- ▶ A review of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) database for areas listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- ▶ A review and consideration of impacts on European and Aboriginal heritage within the Project Area including information from:
 - The Western Australian Heritage Commission;
 - The Australian Heritage Places Inventory;
 - Records held on Municipal databases;
 - National Native Title Tribunal (NNTT); and
 - The Department of Indigenous Affairs.

A consideration of the impacts on:

- ▶ Air quality;
- ▶ Dust;
- ▶ Fauna;
- ▶ Surface waters/drainage;
- ▶ Groundwater;
- ▶ Wetlands and waterways;
- ▶ Noise;
- ▶ Visual amenity; and
- ▶ Reserves and conservation areas.

Providing information to assist in obtaining permits or approvals under legislative provisions, including those required under the following Acts and Regulations:

- ▶ *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.*
- ▶ *Rights in Water and Irrigation Act 1914.*



- ▶ *Conservation and Land Management Act 1984.*
- ▶ *Wildlife Conservation Act 1950.*
- ▶ *Heritage of Western Australia Act 1990.*

2.2 Field Assessment

The Project Area was surveyed by traversing each Section using a vehicle, and undertaking a survey of a series of walking transects within each Material Pit.

Biological Surveys

Biological surveys were undertaken with reference to the Environmental Protection Authority (EPA) Guidance Statement No. 51 (EPA, 2004a) and No. 56 (EPA, 2004b). The surveys included:

- ▶ An examination whether the Project Area is within an Environmentally Sensitive Area (ESA) and the native vegetation in the area to be cleared is in a good or better condition than the rest;
- ▶ A review of the local and regional significance of the plant communities in terms of their intrinsic value, extent, rarity and condition;
- ▶ A description and location, including mapping, of plant communities within the Project Area. Dominant species in each vegetation type was noted, along with any conservation significant flora populations. These communities have been linked to already known, described communities where possible;
- ▶ A rating of condition of the vegetation communities or areas using a published rating scale (Keighery, 1994);
- ▶ A discussion of the presence, location, extent and impact of any plant pests or diseases. GHD notes that dieback is typically not considered to be relevant outside the south-west of Western Australia;
- ▶ An inventory of the vascular plant species in the surveyed area;
- ▶ Where field identification of plant taxa was not possible, specimens were collected in a systematic manner so that they could later be identified by comparison with the reference collection held at the Western Australian Herbarium (WAHERB) and by use of identification keys. Nomenclature of the species follows that of the online *FloraBase* program (<http://florabase.dec.wa.gov.au/>) as it is deemed to contain the most up to date information on flora nomenclature;
- ▶ A review of, and search for, native plant species considered to be rare or potentially endangered. Other species of interest, including those of limited distribution or outliers from their known range, should be discussed. Locations of Threatened (Declared Rare) and/or Priority Flora were mapped at a suitable scale;
- ▶ An inventory of dominant exotic plants, including declared noxious plants and environmental weed species;
- ▶ The provision of advice on whether weeds are likely to spread to, and result in environmental harm to, adjacent areas of native vegetation that is in *Good* or better condition;
- ▶ A review of the fauna species considered to be rare or in need of special protection;
- ▶ An inventory of the vertebrate fauna species in the surveyed area. This was undertaken as a Level 1 targeted search and opportunistic recording of species. Identification of fauna taxa was undertaken



using handbooks, with current nomenclature following that of *NatureMap*. Where taxa could not be confidently identified, specialist zoologists were consulted;

- A review of the presence and abundance of pest, declared or feral animals;
- Identifying any habitats of significance; and
- An assessment of the value of the roadside in providing habitat and facilitating movement between conservation areas.

Heritage Survey

GHD has completed a desktop heritage assessment as part of this project. MRWA has advised that Aboriginal Heritage Surveys have completed at all Material Pits. The survey findings are available upon request from MRWA Gascoyne region.

Noise Survey and Modelling

This project occurs within a remote area. No residential areas occur within the vicinity of the Project Area. As such, GHD considers that construction activity does not require a noise survey or noise modelling works.

Wetland Field Assessment

- A description of existing surface drainage patterns with respect to topography, and to flora and fauna communities; and
- An inventory and brief description of wetlands and their conservation value.

Contaminated Sites Assessment

GHD has completed a desktop contaminated sites assessment as part of this project.

Air Quality Monitoring

This project occurs within a remote area. No residential areas occur within the vicinity of the Project Area. As such, GHD considers that construction activity does not require air quality modelling works.

Dust

This project occurs within a remote area. No residential areas occur within the vicinity of the Project Area. As such, GHD considers that construction activity does not require dust management from a residential perspective. Dust management is considered likely to be required for dust suppression on the gravel roads to ensure safe conditions of for road users during construction works.

Acid Sulphate Soil Assessment

GHD has completed a desktop acid sulphate soils assessment as part of this project.

2.2.1 Field Report

The field report:

- Provides a summary the results of environmental investigations and clearances obtained; and
- Also examines the results of the biological surveys undertaken to allow any proposed clearing of native vegetation to be assessed against the Ten Clearing Principles.



3. Environmental Aspects

Environmental aspects considered for the Project Area are outlined in Table 1.

Table 1 Environmental Aspects

Environmental Aspects	Yes	No	Comments
Biophysical			
Vegetation - Clearing	✓		Vegetation clearing has been assessed using the Ten Clearing Principles. Note that MRWA advises one to two hectares per pit every two year, or as required for maintenance works.
Vegetation - threatened species and communities	✓		Threatened species and communities have been assessed within Section 4.13.
Vegetation - Weeds	✓		Weeds occurring within the area have assessed in Section 4.14.2.
Vegetation - dieback and other diseases or pathogens	✓		Dieback and other disease or pathogens were not considered for this project. Section 4.15 assesses the likelihood of these occurring.
Fauna	✓		Fauna occurring within the area were assessed in section 4.16. The fauna identified during the field survey and habitats that they are likely to occur in were assessed <i>Against the Ten Clearing Principles</i> .
Surface Waters/Drainage (watercourses, erosion, stormwater, disposal, water quality, salinity)	✓		Surface water and drainage were assessed in section 4.9.2.
Wetlands	✓		Wetlands were assessed within section 4.9.1. No wetlands occur within the immediate or within the vicinity of the Project Area.
Groundwater	✓		A number of registered groundwater bores were identified in the immediate vicinity or within the Project Area.
Public Drinking Water Supply	✓		No Public Drinking water supply occurs within the vicinity of the Project Area.
Reserve and Conservation Areas	✓		No conservation areas will be impacted by the proposal.
Acid Sulphate Soil	✓		Acid Sulphates soils were assessed within Section 4.7.
Air Quality		✓	Air quality was assessed within section 4.11.



Environmental Aspects	Yes	No	Comments
Noise and Vibration		✓	Noise and vibration for the proposed there are receptors that occur within proximity of the Project Area.
Contaminated Sites	✓		Contaminated sites were assessed in Section 4.6. No contaminated sites occur within the Project Area.
Social Surroundings		✓	Social surroundings are not considered to be impacted by the proposed works.
European Heritage	✓		European Heritage was assessed in Section 4.4.2. No listed sites occur within the Project Area.
Aboriginal Heritage	✓		Aboriginal Heritage was assessed in Section 4.4.1. No listed sites occur within the Project Area.
Assessment Against the Ten Clearing Principles	✓		An assessment Against the Ten Clearing Principles is shown in Section 6 and Appendix D.



4. Desktop Assessment

4.1 Project Area

The Project Area is located in the Carnarvon region of Western Australia. Two material pits were surveyed as a part of this project. Overall location is shown in Figure 1. Table 2 provides a summary of the approximate area surveyed during the field work.

Table 2 Summary of Project Area Surveyed

Material Pit Name	Approximate Size
NWCH Material Pit 655A Left hand side of NWCH	426 ha
NWCH Material Pit 655B Right hand side of NWCH	612 ha

4.2 Previous Surveys

No known biological surveys have previously been completed within the Project Area.

4.3 Climate

The Carnarvon region has an arid, semi-arid to sub-tropical climate. The average yearly rainfall is 300 mm, with the highest amount of rainfall occurring from January to March. Occasionally tropical cyclones influence the region, causing heavy rain, high temperatures and strong winds, but apart from these erratic conditions the summer is generally dry.

The closest Bureau of Meteorology (BoM) weather station to the project site with continuous reliable data is Learmonth. A summary of the climatic data (BoM, 2012) for this weather station is summarised below:

- ▶ The mean average annual rainfall is approximately 262.0 mm with the majority of rainfall occurring during the summer months;
- ▶ Mean Daily Temperature: 25.4 °C in July to 41.3 °C in January; and
- ▶ Mean Minimum: 25.1°C in February to 11.3°C in July.

4.3.1 2011 Climate

In the three months prior to the survey (August to October) 12 mm rainfall was recorded at Learmonth (Station number 5007). This is comparative to the long-term average of 16.5 mm for this period.

4.4 Land Use

The majority of the Carnarvon region is occupied by pastoral lease land used for extensive grazing of native pastures. The region also is occupied by Aboriginal reserves, mining leases, national parks, nature reserves and estates managed by the DEC.



4.4.1 Indigenous Heritage

The Aboriginal Site Register is held under Section 38 of Western Australia's *Aboriginal Heritage Act 1972*. It protects places and objects customarily used by, or traditional to, the original inhabitants of Australia.

Where an activity disturbs an Aboriginal site or object an application for permission to disturb will need to be submitted under Section 18 of the *Aboriginal Heritage Act 1972*. Where a site of previously unknown Aboriginal heritage is to be disturbed it is advised that a detailed anthropological and archaeological heritage survey is undertaken to find if there are any sites or objects of significance in that area, as it is an offence to disturb all Aboriginal Heritage sites, even those not contained on the Aboriginal Heritage Site Register. In the event that Aboriginal archaeological or ethnographic sites are discovered during construction, there will be a need to meet the requirements of the *Aboriginal Heritage Act 1972*.

A search of the Project Area was undertaken on Department of Indigenous Affairs, Aboriginal Inquiry System. The search indicates that no registered Aboriginal sites occur within the Project Area. In addition MRWA completed a survey in October 2011 and confirmed that no sites of significance are present within the pit site.

4.4.2 European Heritage

Database searches were undertaken to determine whether or not the Project would impact on World Heritage Sites, National Heritage Sites or Commonwealth Heritage Sites.

No non-indigenous heritage sites will be impacted by the proposal.

4.5 Geology and Soils

The Project Area occurs within the Carnarvon Interim Biogeographic Regionalisation of Australia (IBRA) region and Wooramel sub-region. The Wooramel IBRA sub-region forms the southern and central parts of the Carnarvon Basin and is comprised of alluvial plains associated with downstream sections and deltas of Gascoyne, Minilya and Wooramel Rivers (Kendrick and Mau, 2002).

4.6 Contaminated Sites

A search was conducted on the DEC database for Contaminated Sites and their records indicate that there are no contaminated sites existing within the vicinity of the Project Area.

4.7 Acid Sulphate Soils

The DEC (2009) describes Acid Sulphate Soils (ASS) as naturally occurring soils and sediments containing sulphide minerals, predominantly pyrite (an iron sulphide). In an undisturbed state below the water table these soils are benign and not acidic. However, if the soils are drained, excavated or exposed by lowering of the water table, the sulphides will react with oxygen to form sulphuric acid.

Inappropriate disturbance of these soils can generate large amounts of sulphuric acid and leaching of contaminants naturally occurring in soils. Flushing of acidic leachate to ground water and surface waters can cause off site impacts including:

- Ecological damage to aquatic and riparian ecosystems;
- Effects on estuarine fisheries and aquaculture Projects;



- ▶ Contamination of groundwater with arsenic, aluminium and other metals;
- ▶ Reduction in agricultural productivity through metal contamination of soils; (predominantly aluminium); and
- ▶ Damage to infrastructure through the corrosion of concrete and steel pipes, bridges and other sub-surface assets.

The online CSIRO Australian Soil Resource Information System (ASRIS) program indicated the majority of the Project Area occurs in an area that has low to extremely low probability of ASS occurring, but with a very low confidence level of the accuracy of this statement due to a lack of surveys in the area.

The Shared Land Information Portal (SLIP) (Government of Western Australia, 2011) indicates that these areas contain a “low risk” of the presence of ASS.

4.8 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are subject to definition under Section 51B of the *Environmental Protection Act 1986* and may include areas such as those requiring special management attention to protect important scenic values, fish wildlife resources, historical and cultural values, and other natural systems or processes.

The DEC’s online Native Vegetation Map Viewer did not indicate the presence of any ESAs within the vicinity of the Project Area.

4.9 Hydrology

4.9.1 Wetlands

Waterways and wetland areas within the Carnarvon region are ephemeral and generally flow or fill during seasonal rainfall events. A search undertaken on the Western Australian Wetlands Database (*WetlandBase*) and the EPBC Act Protected Matters Search tool indicated no wetlands within the vicinity of the Project Area.

The Project Area does fall within the catchment of Lake MacLeod, with the eastern margin of the lake basin occurring less than 10 km west of the Project Area. Lake MacLeod is registered on the Directory of Important Wetlands by the Government of Australia and is included on the Register of the National Estate. This lake will not be impacted by the proposed works.

Between the Lake MacLeod basin margin and the Project Area are a number of small ephemeral wetlands classified as “non-perennial lakes” (NRM Info, 2012).

4.9.2 Watercourses

No defined watercourses are present within the Project Area, with the nearest defined watercourse (the Lyndon River) occurring four kilometres north of the Project Area. GHD understands that the watercourse will not be impacted by the proposed works.



4.9.3 Public Drinking Water Catchments

A search of the Department of Water (DoW) Geographic Data Atlas indicates that the Project Area is not within, or located in proximity to any Gazetted Public Drinking Water Source Areas (PDWSAs) (Department of Water, 2011). No PDWSAs were identified within the vicinity of the Project Area.

4.9.4 Groundwater

The Project Area occurs within the Carnarvon Artesian Basin (CAB). The CAB is a significant geographical area containing sources of confined or artesian groundwater. No naturally occurring groundwater-dependent ecosystems are known to occur in the CAB geographical area.

Any abstraction of groundwater from the Carnarvon Artesian Basin (the Birdrong Aquifer) requires a 5C Licence from the Department of Water (DoW). The construction or alteration of any new or existing bores requires a 26D Licence from the DoW.

The DoW bore search indicates that there are no known registered groundwater bores within the vicinity of the Project Area.

4.10 Noise and Vibration

There are no residents in close proximity of the proposed works that will be impacted by construction noise or vibration.

4.11 Ambient Air Quality

Soils in the Project Area create a minor potential degradation to ambient air quality during the proposed clearing of vegetation in the Material Pits. Given the isolation of the area, the lack of sensitive receptors and proposed vegetation clearing of up to two hectares every two years, it is considered that dust generated will not cause a significant environmental constraint.

4.12 Reserves and Conservation Areas

A search was undertaken on the DEC database and found no reserves, conservation areas or other DEC managed estates located within the vicinity of the Project Area.

4.13 Vegetation

The Project Area is situated in the Wooramel Sub-region of the Carnarvon Interim Biogeographic Regionalisation of Australia (IBRA) bioregion with two dominant vegetation types as shown below:

- ▶ Hummock grasslands, shrub steppe; acacia & grevillea over *Triodia basedowii*;
- ▶ Low woodland; *Acacia victoriae* & snakewood.

4.13.1 Vegetation Associations

The Beard Vegetation Associations existing within the vicinity of the Project Area are shown in Table 3.



Table 3 Beard Vegetation Associations Within the Project Area

Vegetation Association	Description	Location
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>	Immediate vicinity and including both Material Pits.

4.13.2 Vegetation Extent and Status

A vegetation type is considered to be underrepresented if there is less than 30% of its original extent remaining. From a biodiversity perspective, and taking no account of any other land degradation issues, there are several key criteria applied to vegetation where clearing is still occurring (EPA Position Statement No. 2, December 2000):

- ▶ The “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30% of the pre-European extent of the vegetation type. Vegetation communities where less than 30% of the original vegetation extent remain are referred to as *Vulnerable*; and
- ▶ A level of 10% of the original vegetation extent is regarded as being a level representing an “*Endangered*” vegetation community.

Such vegetation community status can be delineated into five classes, where:

- ▶ *Presumed extinct*: Probably no longer present in the bioregion;
- ▶ *Endangered**: <10% of pre-European extent remains;
- ▶ *Vulnerable**: 10 to 30% of pre-European extent exists;
- ▶ *Depleted**: >30% and up to 50% of pre-European extent exists;
- ▶ *Least Concern*: >50% pre-European extent exists and subject to little or no degradation over a majority of this area.

**or a combination of depletion, loss of quality, current threats and rarity gives a comparable status.*

Native vegetation types represented in the survey areas; their extent and reservation status are drawn from the CAR Reserve Analysis 2009 (Government of Western Australia 2010). Extents at the State, IBRA, IBRA sub-region and the Local Government Area (LGA) (Shire of Carnarvon) level are shown in Table 4. The Vegetation Association 95 is considered to be *Least Concern*.

Table 4 Vegetation Extent and Status

Vegetation Association	Description	Pre-European Extent (Ha)	Current Extent (Ha)	% Remaining	Status
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>	State: 1,224,625.22	State: 1,223,637.42	State: 99.92%	<i>Least Concern</i>
		IBRA: 390078.36	IBRA: 389986.43	IBRA: 99.98%	<i>Least Concern</i>
		Sub-IBRA: 332270.62	Sub-IBRA: 332270.62	Sub-IBRA: 99.97%	<i>Least Concern</i>
		LGA: 385398.15	LGA: 384410.35	LGA: 99.74%	<i>Least Concern</i>

4.13.3 Threatened Ecological Communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blythe, 1997). Threatened Ecological Communities (TECs) are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community i.e. *Presumed Totally Destroyed*, *Critically Endangered*, *Endangered*, and *Vulnerable*.

Some TECs are protected under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Although TECs are not formally protected under the *State Wildlife Conservation Act 1950* (WC Act), the loss of, or disturbance to, some TECs trigger the EPBC Act. The EPA's position on TECs states that proposals that result in the direct loss of TECs are likely to require formal assessment.

Possible TECs that do not meet survey criteria are added to the Department of Environment and Conservation's Priority Ecological Community (PEC) Lists under 1, 2 and 3. These are ecological communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities are placed in Priority 5.

A search of the *NatureMap* program indicated that the Project Area occurs within the buffer of a series of Priority Ecological Communities, which forms a part of the Carnarvon Basin Survey (CB) buffers of the Lake MacLeod Invertebrate Assemblages for CB 76; CB 77; CB 78 and CB 79. The online NRM Info did not corroborate this.

A search of the DEC's Threatened Ecological Communities (TEC) database was undertaken for the Project Area, which indicated that no TECs or PECs occur within the vicinity of the Project Area.

GHD considers that no TECs or PECs will be impacted by this project.

4.14 Flora

4.14.1 Significant Flora

Flora species considered to be under threat are listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the *Wildlife Conservation Act 1950* (WC Act). Any



activities that are deemed to have a significant impact on species that are recognised by these can trigger referral to the Environmental Protection Authority (EPA) and/or the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

A description of conservation categories delineated under the EPBC Act is detailed in Appendix A, Table 11. These are applicable to threatened flora and fauna species.

A search of the EPBC Act Protected Matters Search Tool identified no Commonwealth protected flora species within the boundaries of the Project Area.

In addition to the EPBC Act, significant flora in Western Australia is protected by the WC Act. This Act is administered by the DEC and protects Threatened Flora (Declared Rare) species. The DEC also maintains a list of Priority Flora species. Conservation Codes for flora species are assigned by the DEC to define the level of conservation significance (Appendix A, Table 14). Priority Flora taxa are not protected under the WC Act. Priority Flora may be rare or threatened, but cannot be considered for declaration as rare flora until adequate surveys have been undertaken of known sites and the degree of threat to these populations have been clarified. Special consideration is often given to sites that contain Priority Flora, despite them not having formal legislator protection.

A search was undertaken through the DEC Threatened (Declared Rare) Flora Database, the DEC Declared Rare and Priority List and the Western Australian Herbarium (WAHERB). No Threatened species were indicated to occur within the Project Area. However, 11 Priority Flora were indicated to occur, or potentially occur, within the vicinity of the Project Area. These are shown in Table 5.



Table 5 Results of Conservation Significant Flora Database Searches

Taxon	Conservation Code	Description	Flowering Period	Preferred Habitat	Likelihood of Occurrence in Project Area
<i>Abutilon sp. Quobba</i> (H Demarz 3858)	Priority 2	Erect shrub, 0.5 to 1.5 m high. Flowers: Yellow to orange.	July to September.	Sand.	Extremely unlikely - Known 140 km south-west of the Project Area.
<i>Acacia startii</i>	Priority 3	Dense, rounded, much-branched shrub, 1 to 2 m high, to 3 m wide. Flower: Green to Yellow.	July to August.	Calcareous loam with limestone pebbles. Stony hills and watercourses.	Possible – Known seven kilometres north of the Project Area.
<i>Crinum flaccidum</i>	Priority 2	Bulbaceous, perennial, herb, to 1 m high. Flower: White/cream/yellow.	October to December or January.	Loam, clay, sandstone, swamps and creeks.	Possible - Known 15 km south of the Project Area.
<i>Euphorbia inappendiculata</i>	Priority 3	Spreading, procumbent herb, to 0.4 m high. Flower: Pink.	August.	Clay soils. Among Broken rocky screes.	Extremely Unlikely - Known 160 km east of the Project Area.
<i>Gymnanthera cunninghamii</i>	Priority 3	Erect shrub, 1 to 2 m high. Flower: Cream to yellow to green.	January to December.	Sandy soils.	Possible - Known 35 km south of the Project Area.
<i>Myriocephalus nudus</i>	Priority 1	Annual, herb, to 0.2 m high. Flower: Yellow.	January or April to November.	Moist areas, along rivers and creeks, granite outcrops.	Unlikely - Known 85 km north-east of the Project Area.
<i>Owenia acidula</i>	Priority 3	Tree, 3 to 8 m high. Flowers: White to brown/cream.	August.	Clay.	Possible - Known 40 km south-west of the Project Area.



Taxon	Conservation Code	Description	Flowering Period	Preferred Habitat	Likelihood of Occurrence in Project Area
<i>Rhodanthe ascendens</i>	Priority 1	Ascending annual, herb to 0.1 m high. Flower: Yellow.	August.	Clay and Roadside Verge.	Unlikely - Known 70 km south-east of the Project Area.
<i>Rhodanthe frenchii</i>	Priority 2	Upright annual, herb, to 0.35 m high. Flower: Yellow.	August to October.	Stony hills, rocky river bands and outcrops.	Extremely unlikely - Known 112 km south-east of the Project Area.
<i>Rumex crystallinus</i>	Priority 2	Annual, herb, 0.06 to 0.4 m high.	-	On moist soils and mud on edges of clay pans.	Unlikely - Known 55 km east of the Project Area.
<i>Tephrosia</i> sp. Kennedy Range (JS Beard 4392)	Priority 1	Shrub to 1.5 m tall. Flowers: Magenta and green.	-	Sand dunes, sand over sandstone.	Extremely Unlikely - Known 120 km south-east of the Project Area.



4.14.2 Invasive Flora Species

The EPBC Act Protected Matters Search (DSEWPaC, 2012) indicates that there are potentially two invasive flora species that may occur in the vicinity of the Project Area:

- ▶ **Cenchrus ciliaris* Buffel Grass; and
- ▶ **Lycium ferocissimum* African Boxthorn.

4.15 Diseases or Pathogens

Phytophthora cinnamomi ('Dieback') disease is generally restricted to areas of the south of the State, south of the 26th parallel of latitude, in areas receiving annual rainfall of greater than 400 mm.

The Project Area is not considered to be susceptible to the development of the *Phytophthora cinnamomi* pathogen.

4.16 Fauna

4.16.1 Existing Fauna Records

A search on *NatureMap* was undertaken for the Project Area. The *NatureMap* records show that one amphibian, 24 birds, six mammals and 13 reptiles have been officially recorded in the vicinity of the Project Area. A list of these species is provided in Appendix B, Table 16.

4.16.2 Significant Fauna

The conservation of fauna species and their significance status is currently assessed under both Commonwealth EPBC Act and State WC Act.

Commonwealth

The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). A description of Conservation Categories delineated under the EPBC Act and the circumstances under which a project will trigger referral to the DSEWPaC are described in EPBC Act Fauna Conservation Categories.

The WC Act uses a set of schedules, but also classifies species using some of the IUCN categories. These Schedules are described in Appendix A Table 16.

The EPBC Act protects migratory species that are listed under the following International Agreements:

- ▶ Appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a range state under the Convention;
- ▶ The Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment (CAMBA);
- ▶ The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA);
- ▶ The Agreement between the Republic of Korea and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (ROKAMBA); and



- ▶ All Migratory Listed birds in the annexes to these bilateral agreements are protected in Australia as matters of national environmental significance under the Commonwealth EPBC Act.

The Act also protects marine species on Commonwealth lands and waters.

The DSEWPaC maintains a database of matters of national environmental significance that are protected under the EPBC Act. An EPBC Act Protected Matters Report was generated for the matters of significance that may occur in, or relate to, the study area (DSEWPaC, 2012).

State

In Western Australia the DEC also produces a supplementary list of Priority Fauna, these being species that are not considered Threatened under the Western Australian WC Act but for which the Government feels there is a cause for concern. These species have no special legislative protection, but their presence would normally be considered. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. Levels of Priority are described in Appendix A, Table 13.

A search of the DEC's Threatened Fauna database for any rare and priority species that may occur in the general area has previously been undertaken. These records are from the DEC and the DSEWPaC databases and the Western Australian Museum (WAM). The protected fauna species were identified as potentially occurring within the Project Area are listed in Table 6.

It should be noted that some species that appear in the EPBC Act Protected Matters Search Tool are often not likely to occur within the specified area, as the search provides a general guidance to matters of national significance that require further investigation. The records from the DEC searches of threatened fauna provide more accurate information for the general area; however some records of sightings or trappings can be dated and often misrepresent the current range of threatened species.



Table 6 Conservation Significant Fauna Indicated from Database Searches to Occur within the Vicinity of the Project Area

Genus	Species	Common Name	EPBC Act Status	WC Act Status	Source
<i>Apus</i>	<i>pacificus</i>	Fork-tailed Swift	Mi; Ma	S3	EPBC
<i>Ardea</i>	<i>alba</i>	Great Egret	Mi; Ma	S3	EPBC
<i>Ardea</i>	<i>ibis</i>	Cattle Egret	Mi; Ma	S3	EPBC
<i>Charadrius</i>	<i>veredus</i>	Oriental Plover	Mi; Ma	S3	EPBC
<i>Haliaeetus</i>	<i>leucogaster</i>	White-bellied Sea-Eagle	Mi;Ma	S3	EPBC
<i>Hirundo</i>	<i>rustica</i>	Barn Swallow	Mi;Ma	S3	EPBC
<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater	Mi;Ma	S3	EPBC

Where: *Mi* = Migratory Listed; *Ma* = Marine Listed; *S3* = Schedule 3

4.16.3 Exotic Fauna

The result of the *NatureMap* search indicates that no introduced fauna taxa have been officially reported within the vicinity of the Project Area.

The EPBC Act Protected Matters searches indicate the presence of a total of four exotic (feral) fauna

- ▶ **Capra hircus* (Feral Goats);
- ▶ **Felis catus* (Feral Cat);
- ▶ **Oryctolagus cuniculus* (European Rabbit); and
- ▶ **Vulpes vulpes* (Red Fox).



5. Field Assessment

Field surveys were undertaken by a qualified, experienced field botanist and zoologist with over 15 years experience, Joshua Foster, with assistance from an environmental scientist, Steven Petts.

5.1 Survey Timing

The field surveys were undertaken during November 2011. The survey was completed over a timeframe of one day, undertaken as part of a survey of a number of sites across the local and regional area.

5.1.1 Influence of Climate

The rainfall received by the Project Area prior to the survey is considered to have assisted in the longevity of the 2011 flowering period. In the three months prior to the survey (August to October) 12 mm rainfall was recorded at Learmonth (Station number 5007). This is comparative to the long-term average of 16.5 mm for this period.

5.2 Nomenclature

Nomenclature used in this report follows that used by the DEC's *FloraBase* and *NatureMap*, as these are deemed to contain the most up-to-date species information for Western Australia.

5.3 Taxonomic Identification

5.3.1 Flora

A list of vascular flora species recorded within the Project Area was generated. Where field identification of flora species was uncertain a sample was collected for comparison with taxonomic literature, online databases and the Western Australian Herbarium (WAHERB) reference collection. The presence of Threatened (Declared Rare) or Priority Flora was assessed.

5.3.2 Fauna

Identification of fauna species was made in the field using available field guides. Where identification was not possible photographs of specimens were collected in a systematic manner to be later identified by in-house zoologists.

5.4 Hydrology

5.4.1 Wetlands

No wetlands were recorded in the Project Area.

Wetlands are not considered to occur within or around the Project Area.



5.4.2 Watercourses

No watercourses were identified during the field survey within the vicinity of the Project Area. However, one defined watercourse (the Lyndon River) was identified four kilometres north of the Project Area. GHD understands that the watercourse will not be impacted by the proposed works.

5.5 Vegetation

Project Area vegetation was assessed by traversing by vehicle and walking transects. Relevés were surveyed where an observed change in vegetation occurred to support vegetation description.

5.5.1 Recorded Vegetation Types

A total of three vegetation types were recorded within the Project Area (Table 8), mapped on the basis of similar floristic composition, topography and soils as shown in Figure 2.

5.5.2 Project Area Vegetation Extent

The vegetation types recorded in the Project Area are considered to be of *Least Concern*, with one being equivalent to existing Beard Vegetation Associations.

5.5.3 Project Area Vegetation Condition

The vegetation in the Project Area was given a condition rating based on the vegetation condition ratings scale of Keighery (1994). Condition is based on:

- ▶ Completeness of structural levels;
- ▶ Extent of weed invasion;
- ▶ Historical disturbance from tracks and other clearing or dumping; and
- ▶ The potential for natural or assisted regeneration.

Vegetation condition consists of six rating levels as outlined below in Table 7.





Table 7 Vegetation Condition Scale (after Keighery, 1994)

Assigned Number	Classification	Description
1	<i>Pristine or Nearly So</i>	Pristine or nearly so, no obvious signs of disturbance.
2	<i>Excellent</i>	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.
3	<i>Very Good</i>	Vegetation structure altered obvious signs of disturbance.
4	<i>Good</i>	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	<i>Degraded</i>	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	<i>Completely Degraded</i>	The structure of the vegetation is no longer intact and the area is completely or almost without native species.

The Project Area contained mostly disturbed vegetation, due to historical excavation and vegetation clearing. The Project Area was observed to have *Degraded* to *Good* vegetation condition.



Table 8 Project Area Vegetation Type

Vegetation Type	Short Description	Long Description	Photograph	Condition	Vegetation Association
1	Open Grassland on steppes	Open Grasslands dominated by <i>Triodia</i> spp. (<i>T. basedowii</i>), <i>Aristida holathera</i> , <i>A. contorta</i> , * <i>Cenchrus ciliaris</i> with Scattered Emergent Shrubs of <i>Grevillea eriostachya</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Acacia sclerosperma</i> , <i>Hakea stenophylla</i> subsp. <i>stenophylla</i> over <i>Ptilotus polystachyus</i> , <i>P. obvatus</i> and <i>Salsola</i> sp. (insufficient material)		<i>Degraded to Good</i>	95.
2	Cleared/ Degraded	Material Pits, Scrapes, access tracks. Contains disturbance response species including grasses, Scattered <i>Acacia startii</i> species. .		<i>Degraded</i>	Nil.



5.6 Threatened Ecological Communities

No Threatened Ecological Communities or Priority Ecological Communities were recorded in the Project Area during the field survey.

5.7 Flora

The results of the 2011 field survey indicated that 25 flora taxa from nine families were recorded in the Project Area.

Dominant families were:

- | | |
|------------------------|----------------|
| ▸ Fabaceae (wattles) | Eight taxa; |
| ▸ Malvaceae (grasses) | Five taxa; |
| ▸ Asteraceae (daisies) | Four taxa; and |
| ▸ Poaceae | Four taxa. |

Dominant genera were:

- | | |
|---------------------------|---------------|
| ▸ <i>Acacia</i> (wattles) | Six taxa; |
| ▸ <i>Pluchea</i> | Two taxa; and |
| ▸ <i>Eragrostis</i> | Two taxa. |

The Project Area flora list is indicated in Table 15.

5.7.1 Threatened Flora

No Threatened (Declared Rare) Flora taxa were recorded within the Project Area during the 2011 field survey.

5.7.2 Priority Flora

One Priority 3 Flora taxa was recorded within the Project Area during the 2011 field survey:

Acacia startii (Priority 3) is described as dense, rounded, much-branched shrub, approximately one to two metres tall and up to three metres wide, with green-yellow flowers in July to August (*FloraBase*, 2012). A search was undertaken on *NatureMap* and which reported 48 locations within the Carnarvon IBRA region. This species is known to occur on calcareous loam with limestone pebbles, stony hills and near watercourses. This species is related to the common *Acacia bivenosa*, but within the vicinity of the Project Area the two taxa are not sympatric with *Acacia startii* occurring to the west and south of the range of *Acacia bivenosa*.

In 2011, 156 *Acacia startii* plants were recorded occurring in a distinct area in the centre of Material Pit 4, growing within a rehabilitated area. This species has been identified as a species which responds to disturbances. The population of *Acacia startii* within the Project Area is considered to have been introduced to the site; the result of soil material being relocated and spread as a growth medium during rehabilitation of the site.

Whilst individual plants may be impacted by the proposed works, this species is considered to be widespread in the local and regional area. Recent surveys by GHD undertaken in 2010 along the



Minilya-Exmouth Road indicated that this species is more widespread than indicated by *NatureMap* and *FloraBase* records. Within the vicinity of this Project Area GHD has also recorded a large number of *Acacia startii* along the NWCH roadside, and in disturbed areas associated with other historical MRWA material pits and access tracks.

Given that the habitat preference for this taxon includes recently disturbed areas, GHD considers that this species population within the local and regional area will not be under threat from the proposed project activities. GHD believes that the proposed project activities are likely to enhance the area of preferred habitat and increase germination of this species.

The locations of the *Acacia startii* found within the Project Area are shown in Table 9 and Plate 1. GHD recommends that MRWA is to avoid all known locations, where possible.



Table 9 **Location of *Acacia startii***

Family	Genus	Species	Status	Plant Count	Easting	Northing
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	8	221100	7395305
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221079	7395271
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221118	7395290
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221130	7395331
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	2	221114	7395333
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	4	221116	7395339
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	6	221124	7395336
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221129	7395345
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221125	7395350
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221126	7395355
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	2	221108	7395372
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221106	7395372
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221102	7395358
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221096	7395352
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221079	7395355
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221066	7395358
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	5	221670	7394964
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221907	7395088



Family	Genus	Species	Status	Plant Count	Easting	Northing
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	5	221914	7395062
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	3	221540	7395168
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	15	221742	7395144
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	40	221431	7395149
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	6	221190	7395272
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	10	221133	7395453
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	18	221158	7395487
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	14	221218	7395501
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	2	221235	7395537
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	3	221059	7395624
Fabaceae	<i>Acacia</i>	<i>startii</i>	Priority 3	1	221755	7396246



Plate 1 *Acacia startii* (specimen JFSP30)

5.7.3 Other Significant Flora

One other conservation significant flora species was recorded within the Project Area during the 2011 field survey. *Melaleuca bracteata* exhibits an extension to its known range with no records previously known to occur within the vicinity of the Project Area. A search was undertaken on *NatureMap* and found the closest reported location of this species to be approximately 150 km north from the Project Area.

5.7.4 Weeds and Introduced Species

No weeds or introduced species were recorded within the Project Area:

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WONS) is based on four major criteria:

- Invasiveness;



- Impacts;
- Potential for spread; and
- Socio-economic and environmental values.

No WONS were recorded within the Project Area.

Declared Plants

Weeds that are, or may become, a problem to agriculture or the environment can be formally classified as Declared Plants under the *Agriculture and Related Resources Protection Act 1976* (ARRP Act). The Department of Agriculture and Food (DAFWA) and the Agriculture Protection Board maintains a list of Declared Plants for Western Australia. If a plant is declared for the whole of the State or for a particular Local Government Area, all landholders are obliged to comply with the specific category of control. Declarations specify a category, or categories, for each plant according to the control strategies or objectives which the Agriculture Protection Board believes are appropriate in a particular place.

Among the factors considered in categorising declared plants are:

- The impact of the plant on individuals, agricultural production and the Community in general;
- Whether it is already established in the area; and
- The feasibility and cost of possible control measures.

These Declared Plants are divided into five classes, which are detailed in Table 10.

Table 10 Department of Agriculture and Food Declared Plant Control Classes

Priority Class	Description
P1	Prohibits movement of plants or their seeds within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2	Eradicate infestation to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3	Control infestation in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants.
P4	Prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants.
P5	Infestations on public lands must be controlled.

No Declared Plants pursuant to the ARRP Act were recorded within the Project Area.

Environmental Weed Rating

In developing the Environmental Weed Strategy for Western Australia (EWSWA 1999), criteria for the assessment and ranking of weeds in terms of their environmental impact on biodiversity were formulated. Three criteria were selected to rate weeds. These were:

- Invasiveness,



- Distribution, and
- Environmental impacts.

A list of 467 weeds occurring within the DEC Mid-west region were rated as either high, moderate, mild or low against these criteria. Twenty two weed species were rated as high.

No flora species recorded within the Project Area have been given an Environmental Weed Rating.

In an effort to progress this strategy and an integrated approach to weed management in Western Australia, the Invasive Plant Prioritisation Process for DEC was developed. This is considered likely to supersede the EWSWA environmental weed rankings once complete. The DEC is in the process of examining the weed species for each region. As yet, the status for the majority of the weeds has not yet been determined, and as such the EWSWA ratings remain valid.

5.8 Fauna

5.8.1 Fauna Records

A Level 1 fauna field assessment was conducted in conjunction with the flora survey over one day. The fauna survey was limited to daylight hours and only examined terrestrial animals occurring within the Project Area. A total of seven birds, two mammals and one reptile were recorded from the Project Area. Of the 17 fauna identified none were introduced.

5.8.2 Threatened and Priority Fauna Assessment

There were no Threatened or Priority fauna identified within the Project Area.

The desktop assessment did however indicate that a number of protected fauna may occur within the Project Area. The requirements for preferred habitat and an assessment on the likelihood of these species occurring within the Project Area, based on the field assessment and an online search of known sightings via *NatureMap*, are as follows:

Barn Swallow (*Hirundo rustica*) Listed Migratory, Marine [EPBC Act]; Schedule 3 [WC Act]

The Barn Swallow is migratory species that is widespread throughout Northern Australia and has been sighted in the Carnarvon bioregion. It occurs in open country comprising of low vegetation mainly pastures, meadows and farmlands. This species nests in culverts, stables and barns (DSEWPac, 2012).

Assessment: There is a very low probability of the Barn Swallow occurring within the Project Area because it does not comprise of the appropriate habitat. There is a low probability of this species flying over the area, due to the lack of recorded sightings within the vicinity of the Project Area. A search was undertaken on *NatureMap* and found the closest reported sighting to be more than 500 km from the Project Area. This species is considered unlikely to be impacted by the proposed works.

Cattle Egret (*Ardea ibis*) Listed Migratory, Marine [EPBC Act]; Schedule 3 [WC Act]

The Cattle Egret is a migratory species that are widespread in Australia. They inhabit tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions, however this is extremely rare. This species' diet consists mainly of grasshoppers, however it is known to consume other insects including cicadas, centipedes, spiders, cattle ticks, frogs



(including cane toads), lizards (particularly skinks) and small mammals. In Australia the principal breeding sites are the central east coast from about Newcastle to Bundaberg (DSEWPac, 2012).

Assessment: There is a low probability of the Cattle Egret occurring within the Project Area because it does not comprise of the appropriate habitat. There is a low probability of this species flying over the area, due to the lack of recorded sightings within the vicinity of Project Area. A search was undertaken on *NatureMap* and found the closest reported sighting to be more than 100 km from the Project Area. This species is considered unlikely to be impacted by the proposed works.

Fork-tailed Swift (*Apus pacificus*) Listed Migratory, Marine [EPBC Act]; Schedule 3 [WC Act]

Fork-tailed Swift is distributed along the coastal and sub-coastal areas between Augusta and Carnarvon, including some on near shore and offshore islands. They mainly occur in the inland plains and foothills of the coastal areas. It inhabits riparian woodlands and tea-tree swamps, low scrub, heathland or saltmarsh (DSEWPac, 2012).

Assessment: There is possibility of the Fork-tailed Swift occurring within the Project Area. A search was undertaken on *NatureMap* and found the closest reported sighting to be only 15 km from the Project Area. It is likely for this species to fly over, as sightings have also been recorded inland of the Project Area. GHD considers that this species is highly mobile and therefore it is unlikely to be impacted by the proposed works.

Great Egret (*Ardea alba*) Listed Migratory, Marine [EPBC Act]; Schedule 3 [WC Act]

The Great Egret is a migratory species that are widespread in Australia. They inhabit wetland areas including swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs. This species' diet consists of fish, insects, crustaceans, molluscs, frogs, lizards, snakes and small birds and mammals. In Australia, the largest breeding colonies, and greatest concentrations of breeding colonies, are located in near-coastal regions of the Top End of the Northern Territory.

Assessment: There is a low probability of the Great Egret occurring within the Project Area because it does not comprise of the appropriate habitat. There is a low probability of this species flying over the Project Area, due to the lack of recorded sightings within the vicinity of the Project Area. A search was undertaken on *NatureMap* and found the closest reported sighting to be more than 200 km from the Project Area. This species is considered unlikely to be impacted the proposed works.

Oriental Plover (*Glareola maldivarum*) Listed Migratory, Marine [EPBC Act]; Schedule 3 [WC Act]

The Oriental Plover is a migratory species that occurs across northern and south-eastern Western Australia. They inhabit flat, open, semi-arid and arid grasslands. This includes claypans, dry paddocks, playing fields, lawns and cattle camps, along with open areas recently burnt. The species' diet mainly comprises of insects, including termites, beetles, grasshoppers and crickets (DSEWPac, 2012).

Assessment: There is a low probability of the Oriental Plover occurring within the Project Area because it does not comprise of the appropriate habitat. A search was undertaken on *NatureMap* and found the closest reported sighting to be approximately 80 km from the Project Area. It is likely for the species to fly over the Project Area, as sightings have also been recorded inland of the Project Area. This species is considered unlikely to be impacted the proposed works.



Rainbow Bee-eater (*Merops ornatus*) Listed Migratory, Marine [EPBC Act]; Schedule 3 [WC Act]

The Rainbow Bee-eater is a migratory marine species that is widespread across Australia. This species occurs in open forests and woodlands, shrublands and in various cleared or semi-cleared habitats, including farmlands and developed areas. This species' diet consists of insects such as beetles, moths, butterflies, damselflies, dragonflies, flies, ants and bugs (DSEWPac, 2012).

Assessment: There is high probability of this species occurring within Project Area, as it comprises of the appropriate vegetation type. There is a high probability of this species flying over the Project Area, due to the numerous recorded sightings within the vicinity of the Project Area and the greater surrounds. GHD considers that this species is highly mobile and therefore it is unlikely to be impacted by the proposed works.

White-bellied Sea-eagle (*Haliaeetus leucogaster*) Listed Migratory [EPBC Act]; Schedule 3 [WC Act]

The White-bellied Sea-eagle is a migratory species are widespread along the coastal areas of Western Australia. They occur on coastal dunes, tidal flats, grasslands, heathland, woodlands and within developed areas. This species also is known to occur within the vicinity of freshwater swamps, lakes, reservoirs, billabongs, saltmarshes and sewage ponds. This species' diet comprises of fish, birds, reptiles, mammals and crustaceans (DSEWPac, 2012).

Assessment: There is low probability of this species occurring within the Project Area, as it does not comprise of the appropriate habitat type. There is a low probability of this species flying over the area, due to the lack of recorded sightings within the vicinity of Project Area. A search was undertaken on *NatureMap* and found the closest reported sighting to be approximately 60 km from the Project Area. This species is considered unlikely to be impacted the proposed works.

5.8.3 Exotic Fauna

There were no exotic fauna recorded within the Project Area, during the two day field assessment.

5.8.4 Habitat Value

The majority of the Project Area was assessed as *Degraded to Good* vegetation condition. Disturbance appears to be limited to the maintenance zone of the side access tracks and from historical excavation of Material Pits.

The amount of clearing of two hectares every two years is not considered to impact on the habitat value of the Project Area, particularly where rehabilitation will occur following cessation of material extraction.

5.8.5 Fauna Habitat Types

A total of two fauna habitat types were recorded in the Project Area. These habitats occur in the local and regional area in as good or better condition:

- ▶ Open Grassland on steppes; and
- ▶ Cleared/Degraded.



5.8.6 Habitat Linkages

Habitat linkages are important as it provides fauna a means of moving between areas. Furthermore such linkage also provides a habitat for all ground and aerial fauna for resting and reproduction. It is important to maintain these habitat linkages in areas where extensive clearing has occurred.

The majority of the Project Area comprises of previously disturbed vegetation. MRWA advises that approximately two hectares of vegetation over the timeframe of two years will be impacted by the proposed works; this is less than one percent of the total Project Area. MRWA has advised that they will take a staged pit development approach, which means each one to two hectares will be revegetated at each stage, before opening up new areas of clearing. GHD considers that habitat linkages are unlikely to be impacted the proposed works.



6. Clearing of Native Vegetation

Clearing applications are assessed against ten principles outlined in Schedule 5 of the *Environmental Protection Act* 2003. These principles aim to ensure that all potential impacts resulting from the removal of native vegetation can be assessed in an integrated way. The principles address three main environmental areas:

- ▶ Biodiversity significances;
- ▶ Land degradation; and
- ▶ Ground and surface water quality.

These principles apply to all lands throughout Western Australia. If the project involves significant impacts other than on native vegetation, or the clearing is exempt under Section 51C but is considered to have a significant impact, it should be referred to the EPA for consideration.

Any clearing of native vegetation requires a permit under Part V of the *Environmental Protection Act* 1986, except where exemptions apply under Schedule 6 of the Act or are prescribed in the Environmental Sensitive Areas (ESAs).

6.1 Assessment Against the Ten Clearing Principles

This project has been assessed against the Ten Clearing Principles (Appendix D) and it is considered unlikely to be at variance with any of the Principles.

Clearing Principle (a) includes an examination of Priority Flora taxa, with *Acacia startii* (Priority 3) recorded in the Project Area at a number of locations. GHD considers that this species population within the local and regional area will not be under threat from the proposed project activities. GHD believes that the proposed project activities are likely to enhance the area of preferred habitat and increase germination of this species. However, considering that the records are primarily located in one distinct area of the Project Area, GHD recommends avoiding all known locations, where possible.



7. Recommendation and Approvals Required

7.1 Recommendations

GHD recommends that MRWA avoid all known locations of *Acacia startii* occurring within NWCH Material Pit SLK 655B of the Project Area, where possible.

7.2 Approvals

GHD has not identified any approvals that will be required prior undertaking works within the Project Area.

7.2.1 Commonwealth Government

A review of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) online database was conducted as part of preparing this PEIA. That no environmental impacts or issues considered as having significant impact on nation environmental significance, which would render the project a “Controlled Action” or invoke the Commonwealth EPBC Act.

Formal referral of this project to the Commonwealth Minister for the Environment is not considered warranted.

7.2.2 Government of Western Australia

Environmental Protection Authority

The project proposes to extract material from two pit areas at NWCH SLK 655.

Based on the small scale of this Project, associated level of public interest and minimal environmental impact, it is recommended that this Project does not warrant formal referral to the Environmental Protection Authority (EPA).

Main Road Purpose Permit (818/6) which has been granted to MRWA under Section 51E of the *Environmental Protection Act 1986* allows for the clearance of native vegetation for this project activity. However, this Permit does not authorise the clearance of native vegetation for project activities where:

- ▶ The clearing may be seriously at variance with the clearing principles; or
- ▶ Those project activities are incorporated in any proposal that is referred to and assessed under Part IV of the *Environmental Protection Act 1986* by the EPA.

The project has been assessed to be “not at variance” with any of the Ten Clearing Principles.

Department of Environment and Conservation

This project was found not to be at variance with any of the Ten Clearing Principles. GHD considers that the MRWA Purpose Permit (818/6) is likely to be adequate for the purposes of this project.



8. References

- ABRS 2009. *Australian Faunal Directory*. Australian Biological Resources Study, Canberra. (Online) <http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/index.html>. Accessed March 2012
- BoM (2012). *Climate Statistics for Australian Locations*. (Online) http://www.bom.gov.au/climate/averages/tables/cw_006066.shtml. Accessed March 2012
- Department of Agriculture, Fisheries and Forestry (2011) Australian Soil Resource Information System. (Online) <http://www.asris.csiro.au/asris/>. Accessed November 2011
- Department of Environment and Conservation (2011) Contaminated Sites Database. (Online) <https://secure.dec.wa.gov.au/idelve/css/>. Accessed November 2011
- Department of Environment and Conservation (2012) Native Vegetation Map Viewer. (Online) <http://maps.dec.wa.gov.au/idelve/nv/index.jsp>. Accessed March 2012
- Department of Environment and Conservation (2012) NatureMap; *Mapping Western Australia's Biodiversity*. Search Species By Area. (Online) <http://naturemap.dec.wa.gov.au>. Accessed March 2012
- Department of Environment and Conservation (2012) Vegetation Statistics Statewide 2011 Full report.xls. (Online) <https://www2.landgate.wa.gov.au/web/guest/downloader>. Downloaded March 2012
- Department of Indigenous Affairs (2011) Aboriginal Heritage Inquiry System. (Online) <http://www.dia.wa.gov.au/AHIS/default.aspx>. Accessed November 2011
- Department of Sustainability, Environment, Water, Population and Communities (2011). Australian Heritage Database. (Online) <http://www.environment.gov.au/cgi-bin/ahdb/search.pl>. Accessed November 2011
- Department of Sustainability, Environment, Water, Population and Communities (2011). Protected Matters Search Tool. (Online) <http://www.environment.gov.au/epbc/pmst/index.html>. Accessed November 2011
- Department of Sustainability, Environment, Water, Population and Community (2012). Species Profile and Threats Database (Online) <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl> Accessed March 2012
- Department of Water (2011) Geographic Data Atlas. (Online) <http://www.water.wa.gov.au/idelve/dowdataext/index.jsp>. Accessed March 2012
- Government of Australia (2010). *Weeds in Australia*. (Online) <http://www.weeds.gov.au/index.html>. Accessed March 2012
- Government of Western Australia (2008) Shared Land Information Platform, Natural Resource Management. (Online) http://spatial.agric.wa.gov.au/slip/products_view.asp. Accessed March 2012
- Keighery, B.J. (1994) Bushland Plant Survey. A Guide to Plant Community Survey for the Community. Wildflower Society of WA.



Kendrick and Mau (2002) Carnarvon 2 (CAR2 – Wooramel subregion), Subregional description and biodiversity values. A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002. Department of Conservation and Land Management, October 2002.

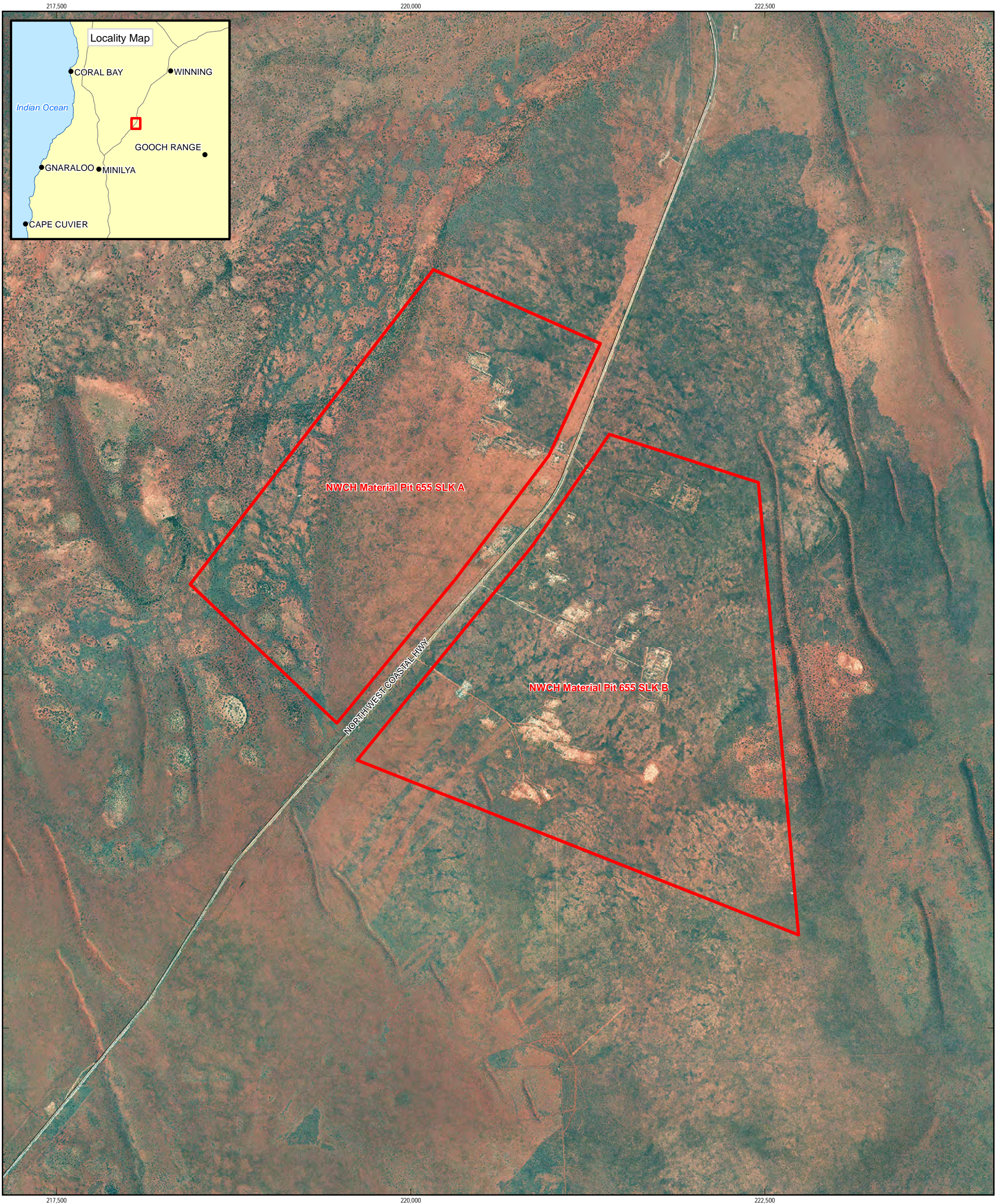
NRM Info (2012). Department of Agriculture and Food WA – Natural Resource Management (NRM) Shared Land Information Portal (SLIP) online maps: <http://spatial.agric.wa.gov.au/slip/framesetup.asp> accessed 30/03/2012.

Western Australian Herbarium (1998–). FloraBase—the Western Australian Flora. Department of Environment and Conservation. (Online) <http://florabase.dec.wa.gov.au>. Accessed March 2012



Figures

Project Figures



LEGEND

— Roads

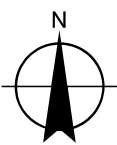
Study Area

1: 25,000 (at A3)

0 125 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50



Main Roads WA
MRWA ETS
NWCH Strategic Material Pits 655 SLK A and B
Preliminary Environment Impact Assessment

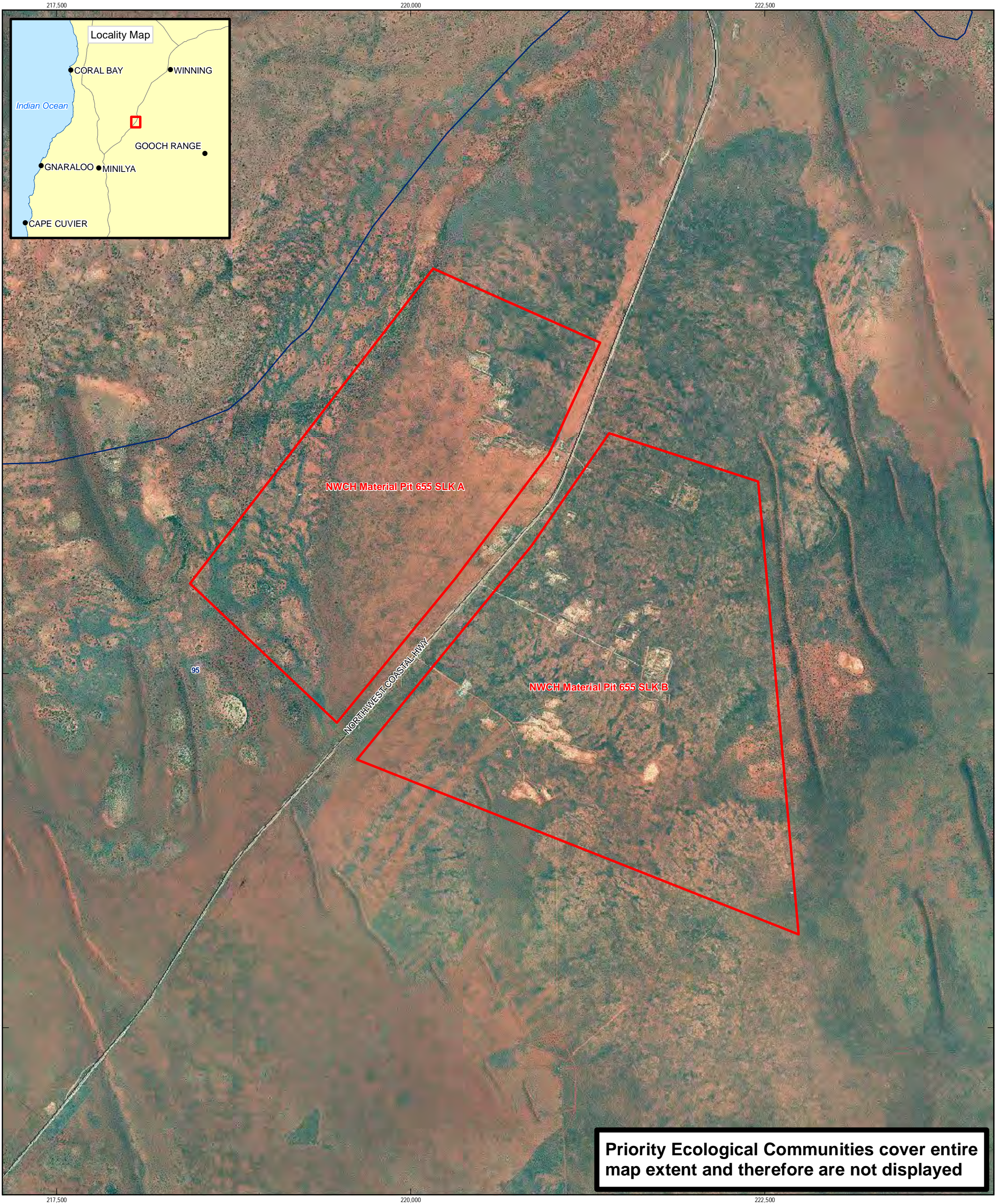
Job Number	61-27568
Revision	0
Date	12 Apr 2012

Locality Map

Figure 1







LEGEND

Threatened (Declared Rare) & Priority Flora

- ▲ (T) Threatened Flora - Extant Taxa
- ▲ Priority 1 - Poorly Known Taxa

- ▲ Priority 2 - Poorly Known Taxa
- ▲ Priority 3 - Poorly Known Taxa
- ▲ Priority 4 - Rare Taxa

- Roads
- Pre-European Vegetation
- Study Area

1: 25,000 (at A3)

0 125 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

CLIENTS | PEOPLE | PERFORMANCE

mainroads
WESTERN AUSTRALIA

powered by
SLIP ENABLER

Main Roads WA
MRWA ETS
NWCH Strategic Material Pits 655 SLK A and B
Preliminary Environment Impact Assessment

Job Number 61-27568
Revision 0
Date 12 Apr 2012

Environmental Constraints

Figure 4



Appendix A

Conservation Categories

EPBC Act Conservation Codes

WC Act Conservation Codes

DEC Conservation Codes



EPBC Act Fauna Conservation Categories

Listed threatened species and ecological communities

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- ▶ Extinct in the wild,
- ▶ Critically Endangered,
- ▶ Endangered, or
- ▶ Vulnerable.

See Table 11.

Critically endangered and endangered species

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- ▶ Lead to a long-term decrease in the size of a population, or
- ▶ Reduce the area of occupancy of the species, or
- ▶ Fragment an existing population into two or more populations, or
- ▶ Adversely affect habitat critical to the survival of a species, or
- ▶ Disrupt the breeding cycle of a population, or
- ▶ Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- ▶ Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*, or
- ▶ Interfere with the recovery of the species.

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.*

Vulnerable species

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- ▶ Lead to a long-term decrease in the size of an important population of a species, or
- ▶ Reduce the area of occupancy of an important population, or
- ▶ Fragment an existing important population into two or more populations, or
- ▶ Adversely affect habitat critical to the survival of a species, or
- ▶ Disrupt the breeding cycle of an important population, or
- ▶ Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or



- ▶ Result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat*, or
- ▶ Interferes substantially with the recovery of the species.
- ▶ An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:
 - ▶ Key source populations either for breeding or dispersal,
 - ▶ Populations that are necessary for maintaining genetic diversity, and/or
 - ▶ Populations that are near the limit of the species range.

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.*

Listed Migratory species

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a listed migratory species. Note that some migratory species are also listed as threatened species. The criteria below are relevant to migratory species that are not threatened.

An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to:

- ▶ Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species, or
- ▶ Result in invasive species that is harmful to the migratory species becoming established* in an area of important habitat of the migratory species, or
- ▶ Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

An area of important habitat is:

1. Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or
2. Habitat utilised by a migratory species which is at the limit of the species range, or
3. Habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an ecologically significant proportion of the population varies with the species (each circumstance will need to be evaluated).

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation.*



Table 11 Conservation Categories and Definitions for *Environmental Protection and Biodiveristy Conservation Act* (1999) Listed Flora and Fauna Species

Conservation Category	Definition
<i>Extinct</i>	Taxa not definitely located in the wild during the past 50 years.
<i>Extinct in the Wild</i>	Taxa known to survive only in captivity.
<i>Critically Endangered</i>	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
<i>Endangered</i>	Taxa facing a very high risk of extinction in the wild in the near future.
<i>Vulnerable</i>	Taxa facing a high risk of extinction in the wild in the medium-term.
<i>Near Threatened</i>	Taxa that risk becoming Vulnerable in the wild.
<i>Conservation Dependent</i>	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
<i>Data Deficient (Insufficiently Known)</i>	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
<i>Least Concern</i>	Taxa that are not considered Threatened.

Table 12 *Western Australia Wildlife Conservation Act* (1950) Conservation Codes

Conservation Code	Description
Schedule 1	"...fauna that is rare or likely to become extinct, are declared to be fauna that is in need of special protection."
Schedule 2	"...fauna that is presumed to be extinct, are declared to be fauna that is in need of special protection."
Schedule 3	"...birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of special protection."
Schedule 4	"...fauna that is in need of special protection, otherwise than for the reasons mentioned [in Schedule 1 – 3]".

Table 13 Department of Environment and Conservation Priority Fauna Codes¹

Conservation Code	Description
Priority 1	Taxa with few, poorly known populations on threatened lands.
Priority 2	Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc.
Priority 3	Taxa which are known from few specimens or sight records, some of which are on lands not under immediate threat of habitat destruction or degradation.
Priority 4	Rare taxa. Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years.
Priority 5	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Table 14 Department of Environment and Conservation Priority Flora Codes

Code	Conservation Category	Definition
X	Presumed Extinct Flora (Declared Rare Flora – Extinct)	Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the Wildlife Conservation Act 1950).
T	Threatened Flora (Declared Rare Flora – Extant)	<p>Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the Wildlife Conservation Act 1950).</p> <p>Threatened Flora are further ranked by the Department according to their level of threat using IUCN Red List criteria:</p> <ul style="list-style-type: none"> ▶ CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild; ▶ EN: Endangered – considered to be face a very high risk of extinction in the wild; and ▶ VU: Vulnerable – considered to be facing a high risk of extinction in the wild.

¹ Species not listed under the Wildlife Conservation Act (1950), but for which there is some concern.



Code	Conservation Category	Definition
P1	Priority 1 – Poorly Known Taxa	Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	Priority 2 – Poorly Known Taxa	Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	Priority 3 – Poorly Known Taxa	Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	Priority 4 – Rare, Near Threatened and other taxa in need of monitoring	<ul style="list-style-type: none"> ▶ Rare. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. ▶ Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. ▶ Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	Priority 5 – Conservation Dependent Taxa	Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within five years.



Appendix B

Project Area Flora List



Table 15 Flora List for North West Coastal Highway Strategic Material Pit SLK 655 A and B

Family	Genus	Species	Common Name	Status
Amaranthaceae	<i>Alternanthera</i>	<i>nodiflora</i>		
Asteraceae	<i>Angianthus</i>	<i>acrohyalinus</i>	Hook-leaf Angianthus	
Asteraceae	<i>Calocephalus</i>	<i>francisii</i>	Fine-leaf Beauty Heads	
Asteraceae	<i>Pluchea</i>	<i>dunlopii</i>		
Asteraceae	<i>Pluchea</i>	<i>rubelliflora</i>		
Boraginaceae	<i>Halgania</i>	<i>cyanea</i> var. Allambi Station (B.W. Strong 676)		
Fabaceae	<i>Acacia</i>	<i>ancistrocarpa</i>	Fitzroy Wattle	
Fabaceae	<i>Acacia</i>	<i>gregorii</i>	Gregory's Wattle	
Fabaceae	<i>Acacia</i>	<i>ramulosa</i> var. <i>linophylla</i>	Horse Mulga	
Fabaceae	<i>Acacia</i>	<i>startii</i>		P3
Fabaceae	<i>Acacia</i>	<i>stellaticeps</i>		
Fabaceae	<i>Acacia</i>	<i>xiphophylla</i>	Snakewood	
Fabaceae	<i>Chorizema</i>	<i>racemosum</i>		
Fabaceae	<i>Tephrosia</i>	<i>gardneri</i>		ms
Malvaceae	<i>Corchorus</i>	<i>crozophorifolius</i>		
Malvaceae	<i>Lawrencia</i>	<i>densiflora</i>		
Myrtaceae	<i>Calytrix</i>	<i>truncatifolia</i>		
Myrtaceae	<i>Melaleuca</i>	<i>bracteata</i>	River Teatree	RE
Myrtaceae	<i>Verticordia</i>	<i>forrestii</i>	Forrest's Featherflower	
Plantaginaceae	<i>Stemodia</i>	sp. Onslow (A.A. Mitchell 76/148)		
Poaceae	<i>Eragrostis</i>	<i>aristidea</i>		
Poaceae	<i>Eragrostis</i>	<i>eriopoda</i>	Woolly Buttgrass	
Poaceae	<i>Eriachne</i>	<i>pergracilis</i>		
Poaceae	<i>Triodia</i>	<i>basedowii</i>		
Proteaceae	<i>Grevillea</i>	<i>eristachya</i>	Flame Grevillea	
Sapindaceae	<i>Diplopeltis</i>	<i>eriocarpa</i>	Hairy Pepperflower	



*Where: *= Introduced/Weed, RE=Range Extension, P3= Priority 3, ms= manuscript: This means the species name has been formally defined but current exists in a manuscript that will be submitted in time to a reputable journal for publication.*



Appendix C

Project Area Fauna List



Table 16 Fauna List for North West Coastal Highway Strategic Material Pit SLK 655 A and B

Type	Family	Genus	Species	Common Name	EPBC	WC	DEC	Exotic	Record	Observed Pit 3	Observed Pit 4
Amphibian	Hylidae	<i>Cyclorana</i>	<i>platycephala</i>	Water-holding Frog					N		
Bird	Accipitridae	<i>Aquila</i>	<i>audax</i>	Wedge-tailed Eagle					N		x
Bird	Accipitridae	<i>Hamirostra</i>	<i>melanostemon</i>	Black-breasted Buzzard					N		
Bird	Accipitridae	<i>Milvus</i>	<i>migrans</i>	Black Kite					N		
Bird	Accipitridae	<i>Haliaeetus</i>	<i>leucogaster</i>	White-bellied Sea-Eagle	Mi; Ma	S3			EPBC		
Bird	Apodidae	<i>Apus</i>	<i>pacificus</i>	Fork-tailed Swift	Mi; Ma	S3			EPBC		
Bird	Ardeidae	<i>Ardea</i>	<i>alba</i>	Great Egret	Mi; Ma	S3			EPBC		
Bird	Ardeidae	<i>Ardea</i>	<i>ibis</i>	Cattle Egret	Mi; Ma	S3			EPBC		
Bird	Casuariidae	<i>Dromaius</i>	<i>novaeollandiae</i>	Emu					N	x	
Bird	Charadriidae	<i>Charadrius</i>	<i>veredus</i>	Oriental Plover	Ma;Mi	S3			EPBC		
Bird	Cinclosomatidae	<i>Psophodes</i>	<i>occidentalis</i>	Western Wedgebill					N		
Bird	Corvidae	<i>Corvus</i>	<i>bennetti</i>	Little Crow					N		
Bird	Corvidae	<i>Corvus</i>	<i>orru</i>	Torresian Crow					N		
Bird	Dicruridae	<i>Rhipidura</i>	<i>leucophrys</i>	Willie Wagtail					N		
Bird	Estrilidae	<i>Taeniopygia</i>	<i>guttata</i>	Zebra Finch					N	x	x



Type	Family	Genus	Species	Common Name	EPBC	WC	DEC	Exotic	Record	Observed Pit 3	Observed Pit 4
Bird	Falconidae	<i>Falco</i>	<i>berigora</i>	Brown Falcon					N		x
Bird	Hirundinidae	<i>Hirundo</i>	<i>rustica</i>	Barn Swallow	Mi; Ma	S3			EPBC		
Bird	Maluridae	<i>Malurus</i>	<i>leucopterus</i>	White-winged Fairy-wren					N	x	
Bird	Meliphagidae	<i>Acanthagenys</i>	<i>rufogularis</i>	Spiny-cheeked Honeyeater					N		
Bird	Meliphagidae	<i>Lichenostomus</i>	<i>keartlandi</i>	Grey-headed Honeyeater					N		x
Bird	Meliphagidae	<i>Lichenostomus</i>	<i>penicillatus</i>	White-plumed Honeyeater					N		
Bird	Meliphagidae	<i>Lichenostomus</i>	<i>virescens</i>	Singing Honeyeater					N	x	
Bird	Meropidae	<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater	Mi; Ma	S3			EPBC		
Bird	Pachycephalidae	<i>Oreoica</i>	<i>gutturalis</i>	Crested Bellbird					N		
Bird	Sylviidae	<i>Cincloramphus</i>	<i>mathewsi</i>	Rufous Songlark					N		
Mammal	Bovidae	<i>Bos</i>	spp.	Cattle	*				N	x	x
Mammal	Bovidae	<i>Capra</i>	<i>hircus</i>	Goat	*				EPBC		
Mammal	Canidae	<i>Vulpes</i>	<i>vulpes</i>	Red Fox	*				EPBC		
Mammal	Felidae	<i>Felis</i>	<i>catus</i>	Cat	*				EPBC		
Mammal	Leporidae	<i>Oryctolagus</i>	<i>cuniculus</i>	Rabbit	*				EPBC		
Mammal	Macropodidae	<i>Macropus</i>	<i>robustus</i>	Euro					N		x



Type	Family	Genus	Species	Common Name	EPBC	WC	DEC	Exotic	Record	Observed Pit 3	Observed Pit 4
Reptile	Agamidae	<i>Ctenophorus</i>	<i>clayi</i>	Collared Dragon					N		
Reptile	Agamidae	<i>Ctenophorus</i>	<i>isolepis</i> subsp. <i>isolepis</i>						N		
Reptile	Agamidae	<i>Ctenophorus</i>	<i>nuchalis</i>	Central Netted Dragon					N		
Reptile	Agamidae	<i>Ctenophorus</i>	<i>reticulatus</i>	Western Netted Dragon					N		
Reptile	Agamidae	<i>Ctenophorus</i>	<i>rubens</i>	Red Dragon					N	x	
Reptile	Elapidae	<i>Pseudonaja</i>	<i>modesta</i>	Ringed Brown Snake					N		
Reptile	Elapidae	<i>Simoselaps</i>	<i>bertholdi</i>	Jan's Banded Snake					N		
Reptile	Gekkonidae	<i>Gehyra</i>	<i>variegata</i>						N		
Reptile	Scincidae	<i>Ctenotus</i>	<i>hanloni</i>						N		
Reptile	Scincidae	<i>Lerista</i>	<i>macropisthopus</i> subsp. <i>fusciceps</i>						N		
Reptile	Scincidae	<i>Lerista</i>	<i>micra</i>						N		
Reptile	Scincidae	<i>Lerista</i>	<i>petersoni</i>						N		
Reptile	Scincidae	<i>Lerista</i>	<i>uniduo</i>						N		

Where: *=Introduced, V= Vulnerable, E= Endangered, S1=Schedule 1, S3= Schedule 3, P4 = Priority 4, Mi = Migratory, Ma = Marine



Appendix D

Assessment Against the Ten Clearing Principles



(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Plant Species</p> <ul style="list-style-type: none"> ▶ Total Vascular Plant Taxa <ul style="list-style-type: none"> – A total of 25 flora taxa from nine families were recorded from the Project Area, representing a moderate level of diversity, with no weed species. This total is considered to be similar to that found in the local and regional area. ▶ Vascular Plant Taxa Diversity <ul style="list-style-type: none"> – Diversity in the Project Area is considered to be comparable to that found in the local area; in similar habitat that has areas of disturbance (e.g. roads, tracks, pastoral stations). ▶ Priority Flora, Significant Flora <ul style="list-style-type: none"> – One Priority Flora taxa was recorded within the Project Area: <ul style="list-style-type: none"> • <i>Acacia startii</i> (Priority 3). – This species is related to the common <i>Acacia bivenosa</i>, but within the vicinity of the Project Area the two taxa are not sympatric, with <i>Acacia startii</i> occurring to the west and south range of <i>Acacia bivenosa</i>. In 2011, 156 plants were recorded occurring in a distinct area in the centre of Material Pit 4, growing within a rehabilitated area, for which reason the vegetation condition was rated <i>Degraded</i>. This species has been identified as a species which responds to disturbance. – The population of <i>Acacia startii</i> within the Project Area is considered to be introduced to the site, and is rather the result of soil material being relocated and spread as a growth medium during rehabilitation of the site. Whilst plants may be impacted by the proposed works, this species is considered to be widespread in the local and regional area. Recent surveys by GHD undertaken in 2010 along the Minilya- Exmouth Road indicated that this species is more widespread than indicated by <i>NatureMap</i> and <i>FloraBase</i> records. Within the vicinity of this Project Area GHD has also recorded a large number of <i>Acacia startii</i> along the NWCH roadside, and in disturbed areas associated with other MRWA Roads material pits and access tracks. <p>Fauna Species</p> <ul style="list-style-type: none"> ▶ Total Fauna Taxa <ul style="list-style-type: none"> – The reconnaissance fauna survey recorded one amphibian, 24 birds, six mammals and 13 reptile species from the Project Area. The survey result was considered to be a relatively good reflection of fauna species present. <p>Ecosystem Diversity</p> <ul style="list-style-type: none"> ▶ Number of Ecological Communities (Plant, Fauna) <ul style="list-style-type: none"> – A total of two vegetation types and two fauna habitats were recorded within the Project Area. This includes a cleared/degraded vegetation type/habitat, and a degraded vegetation population of <i>Acacia startii</i>. These communities are also present in the local area in similar or better condition.
	<ul style="list-style-type: none"> ▶ Habitat Diversity <ul style="list-style-type: none"> – Habitats (macro- and microhabitats) found in the Project Area are also present in the local area in similar or better condition. ▶ Variety of Soil Types/Geological Formations



	<ul style="list-style-type: none"> – Soil types or geological formations in the Project Area are also present in the local and regional area.
Assessment	<p>Project is considered unlikely to be at variance with clearing principle. Given that the habitat preference for <i>Acacia startii</i> includes recently disturbed areas, GHD considers that this species population within the local and the regional area will not be under threat from the proposed project activities. GHD believes that the proposed project activities are likely to enhance the area of preferred habitat and increase germination of this species.</p>

(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Significant Fauna</p> <ul style="list-style-type: none"> ► Threatened Fauna <ul style="list-style-type: none"> – The desktop assessment indicated that threatened fauna may potentially utilise the Project Area. Significant habitat for threatened fauna was not recorded within the Project Area, with the habitat considered to be common in the local and regional area. No Threatened Fauna taxa were recorded from the Project Area. ► Priority Fauna <ul style="list-style-type: none"> – The desktop assessment indicated that priority fauna may potentially utilise the Project Area for foraging. No Priority fauna species were recorded within the Project Area. ► Other Significant Fauna <ul style="list-style-type: none"> – The desktop assessment indicated that significant fauna may occur in the Project Area. No EPBC Act Marine and/or Migratory Listed species were recorded within the Project Area. <p>Habitat</p> <ul style="list-style-type: none"> ► Significant Habitat / Habitats of Significance <ul style="list-style-type: none"> – No habitat deemed to be significant occurs within the Project Area. Habitat in the Project Area also occurs in the local area in similar or better condition. The habitat in the Project Area is disturbed by road maintenance and pastoral activities. ► Habitat Extent and Retention <ul style="list-style-type: none"> – Habitats recorded in the Project Area are also found in the local area in similar or better condition. The proposed Project will not significantly diminish the extent of these habitats. ► Ecological Corridors. <ul style="list-style-type: none"> – The habitat in the Project Area occurs in a region with relatively undisturbed ecological corridors. Existing corridors are not considered to be significantly modified by the proposed project.
Assessment	Project is considered not to be at variance with this clearing principle.



(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Rare Flora</p> <ul style="list-style-type: none"> ▶ Presence <ul style="list-style-type: none"> – No Threatened (Declared Rare) Flora taxa were indicated to occur within the vicinity of the Project Area as a result of database searches. No Threatened (Declared Rare) Flora taxa were recorded in the Project Area during the field survey. ▶ Habitat <ul style="list-style-type: none"> – No habitat considered to be required for the continued existence of Threatened Flora is considered to be present in the Project Area.
Assessment	Project is considered not to be at variance with this clearing principle.

(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Vegetation</p> <ul style="list-style-type: none"> ▶ Extent and Status <ul style="list-style-type: none"> – Vegetation Associations within the vicinity of the Project Area are considered to be of Least Concern with >90% remaining. – Vegetation types recorded in the Project Area are considered to be equivalent to the Vegetation Associations indicated by Beard. ▶ Communities <ul style="list-style-type: none"> – No Threatened Ecological Communities were recorded from the Project Area. – The buffer of four Priority Ecological Communities overlaps the Project Area. These PECs includes CB 76, CB 77, CB 78 and CB 79 of the Lake MacLeod Invertebrate Assemblages. GHD considers that no TECs or PECs will be impacted by this project. ▶ Areas <ul style="list-style-type: none"> – No Environmentally Sensitive Areas occur within or immediately adjacent to the Project Area.
Assessment	Project is considered not to be at variance with this clearing principle.



(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Vegetation</p> <ul style="list-style-type: none"> ▶ Extent and Status <ul style="list-style-type: none"> – Vegetation Associations within the vicinity of the Project Area are considered to be of Least Concern with >90% remaining. – Vegetation types recorded in the Project Area are considered to be equivalent to the Vegetation Associations indicated by Beard. ▶ Regionally Significant Areas <ul style="list-style-type: none"> – Vegetation within the Project Area is not considered to contain communities required to maintain ecosystem services (e.g. hydrological processes).
Assessment	Project is considered not to be at variance with this clearing principle.

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Watercourses and Wetlands</p> <ul style="list-style-type: none"> ▶ Hydrology <ul style="list-style-type: none"> – No watercourses or wetlands occur within the Project Area in the desktop assessment. – No ephemeral watercourses were recorded within the vicinity of the Project Area, during the field survey. ▶ Groundwater Dependent Ecosystems <ul style="list-style-type: none"> – No groundwater dependent ecosystems occur within or adjacent to the Project Area.
Assessment	Project is considered not to be at variance with this clearing principle.



(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Land Degradation</p> <ul style="list-style-type: none"> ▶ Soil Erosion <ul style="list-style-type: none"> – Erosion from wind or water is considered to be minimal. Much of the surrounding land surface is well vegetated. – The clearing of native vegetation is not expected to alter the quality or quantity of water run-off in or adjacent to the Project Area. Waterlogging and changes to nutrient levels are not expected to be altered by the clearing of vegetation in the Project Area. ▶ Soil Acidity <ul style="list-style-type: none"> – The clearing of vegetation is not considered to alter soil acidity in or adjacent to the Project Area. ▶ Salinity <ul style="list-style-type: none"> – The clearing of vegetation is not considered to significantly alter the hydrological balance and cause a change in the salinity either on- or off-site.
Assessment	Project is considered not to be at variance with this clearing principle. MRWA proposes to clear one to two hectares of vegetation every two years, or when maintenance and project works are required. MRWA has advised that they will take a staged pit development approach, which means each one to two hectares will be revegetated at each stage, before opening up new areas of clearing.

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Conservation Areas</p> <ul style="list-style-type: none"> ▶ Protected Areas <ul style="list-style-type: none"> – The Project Area is not adjacent to, or in the vicinity of a conservation reserve or protected area. ▶ Fragmentation <ul style="list-style-type: none"> – The Project Area occurs in an area where the vegetation is relatively unfragmented. ▶ Ecological Linkages <ul style="list-style-type: none"> – The Project Area occurs in a region where the vegetation ecological linkages remain mostly intact. Existing ecological linkages are not considered to be impacted by the proposed works.
Assessment	Project is considered not to be at variance with this clearing principle.



(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Water Quality</p> <ul style="list-style-type: none"> ▶ Catchment Areas <ul style="list-style-type: none"> – The Project Area does not occur within a proclaimed Public Drinking Water Supply Catchment. ▶ Groundwater <ul style="list-style-type: none"> – The clearing of vegetation is not considered to cause an alteration to the quality of groundwater in or adjacent to the Project Area. – No groundwater dependent ecosystems occur in or adjacent to the Project Area. ▶ Surface Water <ul style="list-style-type: none"> – The clearing of vegetation is not considered to cause an alteration to the quality of surface waters in or adjacent to the Project Area.
Assessment	Project is considered not to be at variance with this clearing principle.

(j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

Methodology	Desktop assessment of available information and field survey results
Survey Results	<p>Water Quantity</p> <ul style="list-style-type: none"> ▶ Flooding <ul style="list-style-type: none"> – The clearing of vegetation in the Project Area is not considered to alter the frequency or intensity of flood events. Runoff coefficients in the Project Area are not likely to be significantly altered by the clearing of native vegetation.
Assessment	Project is considered not to be at variance with this clearing principle.



GHD

Level 1, 209 Foreshore Drive Geraldton WA 6530 Australia
T: (08) 9920 9400 F: (08) 9920 9499 E: getmail@ghd.com.au

© GHD 2012

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	C. Wharton	J. Foster		J. Foster		11/04/2012